STUDIES ON MARINE BRYOZOA. II. BARENTSIA LAXA KIRKPATRICK 1890

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Introduction

The purpose of the present study is (1) to report the occurrence of *Barentsia laxa* Kirkpatrick, 1890, an Entoproct of the Family Pedicellinidae, in the waters of Woods Hole, Massachusetts, thus adding to the list of species already reported from that area; (2) to call attention to the interesting association between this species and *Cliona*-supporting *Venus* shells; and (3) to give a more detailed, more completely illustrated account of the morphology and reproduction of this species than has been available up to now.

Most grateful acknowledgment is due the Marine Biological Laboratory of Woods Hole, Massachusetts, whose Supply Department and Collecting Crew dredged the specimens, and also to the Laboratory for working facilities without which this study would not have been possible.

History

Barentsia laxa was originally described by Kirkpatrick (1890, p. 624, Pl. XVII, Fig. 6) from a station between Orman's Reef and Brothers Island (Gaba), Torres Straits, which are between Australia and New Guinea. It was next reported from the Bay of Bima and east of Pajunga Island, Kwandang Bay, the Malay Archipelago, by Harmer (1915, p. 32, Pl. II, Figs. 10–11). Livingstone (1927, p. 69) reported it from the coastal waters of Queensland, the Great Barrier Reef and outlying islands of Australia. Hastings (1932, p. 401) briefly noted that *Barentsia laxa* had been previously reported from Australian waters. Marcus (1938, pp. 10–11, Pl. II, Fig. 3; 1939, pp. 212–214, 275, Pl. 20, Fig. 51) reported it from the Bay of Santos, Brasil, and Osburn (1944, pp 10–11, Fig. 3) reported it from Chincoteague Bay, Chesapeake Bay and from a station 15 miles east of Great Point , Nantucket Island (in the Atlantic Ocean). The species thus has been reported only a few times and from widely separated areas.

Barentsia laxa was found on various substrates by the aforementioned workers: (1) on *Flustra cribriformis* by Kirkpatrick; (2) on a coral, *Porites*, by Harmer; (3) on coral, shells, sea weeds and other Bryozoa by Marcus (1938, p. 10); and (4) on hydroid stems, oyster shells and over *Anguinella palmata* by Osburn. The exact dates of collection or the breeding time of *Barentsia laxa* have not been recorded by the earlier workers although some observed larvae in the colonies. Such data would be useful to those doing experimental work on the species.

The following data are based entirely on the *Barentsia laxa* specimens collected at Woods Hole.

Collection Data

The present *Barentsia laxa* was collected in Great Harbor, Woods Hole, Massachusetts, at a depth of approximately 30 to 50 feet, on the following dates: VII-25-1945, VIII-10-1945, VII-25-1946, VIII-8-1946, VII-25-1947, VIII-7-1947 and VIII-28-1947.

A number of empty *Venus* shells encrusted with yellow, boring *Cliona* sponge, dredged by the Collecting Crew for use in the Invertebrate Zoology Course of the M.B.L., were transferred to aquaria which were supplied with running sea water. On these shells were tufts of *Barentsia laxa,* half an inch tall and from one-half to one inch in extent. The colonies were a tan or grey color and of rather soft texture. Some of the *Venus* shells were badly riddled and covered with sponge. The *Barentsia* was more abundant on these than on the cleaner, less diseased shells. It grew as well directly on the sponge surface itself, that is, on the patches of sponge covering or eating through the shell, as it did on the shell proper. It was much easier to scrape the *Barentsia* from the sponge surface than from the shell surface; thus the stolons as well as the rest of the colony could be obtained intact. Although numerous *Pecten, Crepidula,* other Pelecypod and Gastropod shells were dredged from Great Harbor, they seemed to be much less utilized as substrates by *Barentsia laxa* than were the *Cliona*-infested *Venus* shells. However, some fine extensive colonies were found on a large cinder clinker, so *B. laxa* is not found exclusively on shells or other animals.

Barentsia laxa colonies are quite hardy and very easy to keep in the laboratory without any particular care or feeding other than to have fresh running sea water flowing constantly into their aquarium. Colonies collected in July 1947 were still alive by September 4, 1947, although many of the individuals had lost their heads and were in the process of regenerating new ones. Some of the slender stalks were headless but still alive and writhing about.

Free-swimming larvae and embryos in various stages of development were obtainable throughout the time of study (July 25 to September 4) and very probably considerably earlier and later.

General Morphology

Barentsia laxa is the third *Barentsia* species to be reported from the immediate vicinity of Woods Hole. The other two, *B. discreta* and *B. major,* were reported by Osburn (1912, pp. 13–14).

Barentsia laxa forms colonies of numerous pin-like individuals crowded together to make a soft furry mass or tuft sometimes up to one-half inch in height. The colonies grow somewhat more frequently on the inner protected surface of an empty *Cliona*-infested *Venus* shell near the hinge and umbo than elsewhere. Each zoid consists of three major parts: the calyx (head), stalk, and swollen base. Each zoid is connected with neighboring zoids by stolons of varying length. Measurements of these various parts are given in Table I and the parts are illustrated on Plate I.

TABLE I

Comparison of the Woods Hole Barentsia laxa specimens with those from other localities

	Woods Hole specimens				Other *Barentsia laxa* specimens			
	No. of readings	Maximum	Minimum	Average	Harmer (1915, pp. 32–33)	Kirkpatrick (1890, p. 624)	Marcus (1938, p. 10)	Osburn (1944, pp. 10–11)
Calyx length, with tentacles rolled in	21	.518 mm.	.216 mm.	.300 mm.	.480 mm.	.4–.5 mm.	.400 mm.	.55–.78 mm.
Calyx width, with tentacles rolled in	22	.432 mm.	.144 mm.	.240 mm.	.365 mm.	.35–.4 mm.	.330 mm.	.40–.52 mm.
Stalk length	60	9.045 mm.	.374 mm.	4.810 mm.	2.500 mm.		1.600 mm.	
Stalk width, near calyx	20	.137 mm.	.029 mm.	.078 mm.	.080 mm.		.075 mm.	
Stalk width, near basal enlargement	20	.048 mm.	.029 mm.	.038 mm.	.032 mm.		.040 mm.	
Musclium length, from septum to base	24	.576 mm.	.216 mm.	.359 mm.	.480 mm.	.25 mm.	.350 mm.	.20–.35 mm.
Musclium width	24	.245 mm.	.086 mm.	.134 mm.	.190 mm.	.16 mm.	.150 mm.	.12–.20 mm.
Stolen length	12	1.008 mm.	.072 mm.	.464 mm.				
Stolon width	22	.058 mm.	.029 mm.	.039 mm.			.045 mm.	
Total length (calyx, stalk and musclium lengths added)	2	9.867 mm.	1.024 mm.		3.460 mm.	3.00 mm.	2.350 mm.	6.5 mm. maximum
Tentacle number	50	23	13	17	about 20		about 20	

Calyx

The calyx (Figs. 23, 24, 26, 30, 32, 33) bears the tentacles, digestive tract, reproductive system, larvae, nephridia, ganglia and nerves, and is at the tip of the slender stalk which connects it with the musclar base.

The anterior, esophageal side of the calyx is flattened. The posterior, intestinal side is more curved (gibbose). Its wall is relatively thin and transparent. Internal organs are readily visible. The lophophore may be contracted, with tentacles bent inward, as shown in Figures 19, 20, 24 and 33, or may be expanded with tentacles spread outward, as in Figures 5, 16 and 22. A strong circular muscle layer, whose fibers are indicated in Figures 19, 22, 24, 30 and 33, is present in the calyx rim, making possible the closure of the calyx rim or velum over the rolled in tentacles. The observed tentacle number ranged from 13 to 23.

The inner surfaces of the tentacles and the floor of the atrium are ciliated (Fig. 16).

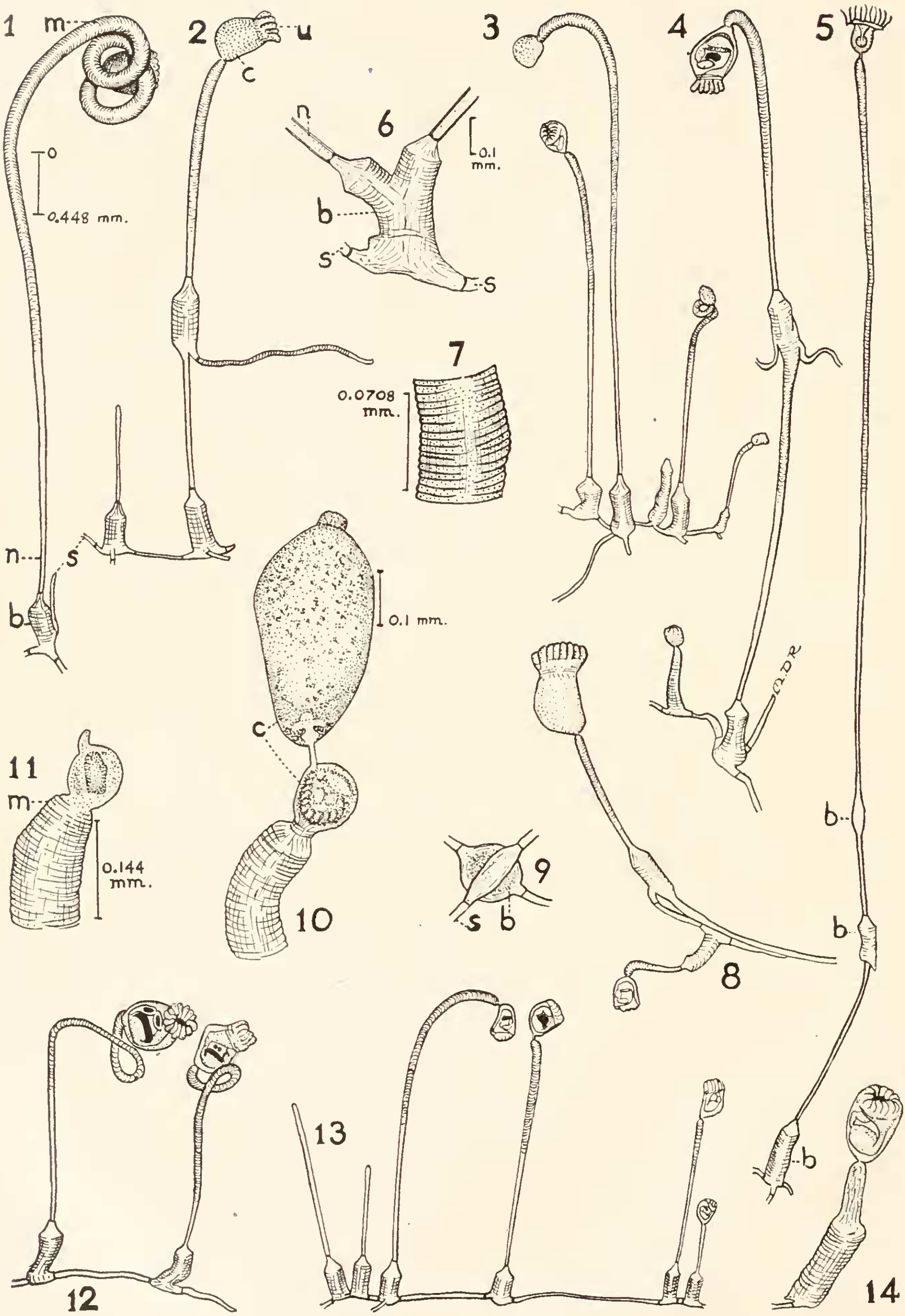
Into the atrium open the mouth, anus, nephridia and reproductive organs.

The most conspicuous set of organs within the calyx is the digestive tract. Its walls are very clearly defined. The tract consists of mouth, pharynx, esophagus, esophageal valve, stomach (whose upper wall is thickened into a so-called "liver"), intestine, rectum and anus. The pharynx is wider than the esophagus which is a fairly long vertical tapering tube (Figs. 15, 24). Beyond the esophageal valve is the horizontal, much enlarged sac-like stomach whose wall varies in thickness in different areas and in different physiological states. The "liver" differs in color from the rest of the tract. It is a deep yellow, sometimes brownish color while the rest of the tract is white or gray. Large cells stud its surface (Figs. 15, 17, 18, 24). The sphincter between stomach and intestine may at times be so relaxed (Fig. 26) that the boundary between the two organs is hard to define. This is true when a continuous mass of food begins to revolve in both organs at the same time, or when food begins to pass from the stomach into the intestine. At other times, the boundary between stomach and intestine is very easy to see (Fig. 23). The intestine leads upward, somewhat at an angle, toward the horizontally placed rectum. The rectum is partially hidden by the lophophore, atrium, tentacles and gonads. When full it may cause an elevation of the atrial floor (Fig. 42).

All the chambers of the digestive tract are ciliated although the cilia may be more prominent in some parts of the gut than in others. A very conspicuous tuft of cilia is found at the entrance to the stomach, near the esophageal valve (Fig. 24). Shorter cilia occur in other parts of the stomach also (roof, sides and floor) but the abovementioned tuft is the most conspicuous. Cilia line the intestine and rectum also.

Barentsia laxa feeds on Protozoa, Bacteria, other small organisms and debris. The food seems to get entangled in a strand of mucus in the stomach and the whole mass may rotate for a time in one direction (Figs. 23, 26), then reverse and rotate in the opposite direction, because of the action of the cilia lining the tract. The lower end of the mucus strand is attached for a time to the stomach wall. Fecal pellets rotate in either direction in the intestine and rectum as does the food mass in the stomach.

PLATE I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Explanation of Plate I

Figures 2, 8 and 9 are free-hand drawings; the remainder on this plate were drawn with the aid of a camera lucida. The scale alongside Figure 1 applies to Figures 1, 3, 4, 5, 12 and 13. The scale alongside Figure 6 applies to that figure alone. The scale alongside Figure 7 applies to that figure alone. The scale alongside Figure 10 applies to that figure alone. The scale alongside Figure 11 applies to Figures 11 and 14. All Figures were drawn from living specimens of *Barentsia laxa.*

Figure 1. *Barentsia laxa* zoid showing great flexibility of the upper part (pedicel) of the stalk. The pedicel is shown in a double coil, almost hiding the head. The lower part of the stalk is less flexible.

Figure 2. A colony of two individuals, one of which has lost its head and the other provided with an "elbow" or additional intercalated musclium from which arises an annulated stalk or stolon, an unusual condition. These jointed individuals are very scarce in this species. A septum has not yet formed immediately below the intercalated musclium.

Figure 3. A small colony of four zoids of differing age and length connected by short stolons. Most colonies were of this type, i.e., without additional musclia intercalated between the basal musclium and the calyx.

Figure 4. Shows the great contrast in length between a young and an old zoid. The large older zoid is unusual in that it is "elbowed" or provided with an intercalated musclium from which arise two stolons. This is not so frequent a condition as that of Figure 3.

Figure 5. An unusually long zoid with two fully formed musclia (*b*) and the beginning of a third. The middle musclium was separated from the stalk by a septum above and below. The uppermost enlargement apparently was not yet far enough developed to have septa. The calyx on this specimen had about 17 tentacles.

Figure 6. An unusual basal musclium, fused at the lower end and split at the upper end.

Figure 7. Portion of a pedicel showing the closeness of the annulations. A few of the longitudinal muscle fibers are indicated.

Figure 8. Another unusual condition, that of an intercalated musclium giving rise to a stolon which continues to grow along the parent stalk, using the latter as a substratum.

Figure 9. View of a basal musclium as seen from the basal or attached surface, showing the relative position and point of origin of four stolons.

Figure 10. An old degenerated calyx is attached by a thin strip of tissue to a newly developing calyx which is being differentiated from the tip of the pedicel.

Figure 11. A pedicel is topped by a young, regenerating calyx. The old calyx has been lost, leaving the small protoplasmic projection from the upper left surface of the young calyx as the only remnant of the connection between old and new calyces. The contents of the young calyx of Figure 11 are not as far along in development as the calyx contents of Figure 10, or more properly, the zoid of Figure 11 lost its old calyx sooner than did the zoid of Figure 10. This mode of calyx loss and regeneration is not uncommon, several zoids having been found in various stages of degeneration and regeneration.

Figure 12. Two zoids showing the characteristic coiling and ceaseless twisting about of the upper part of the flexible *Barentsia laxa* stalks.

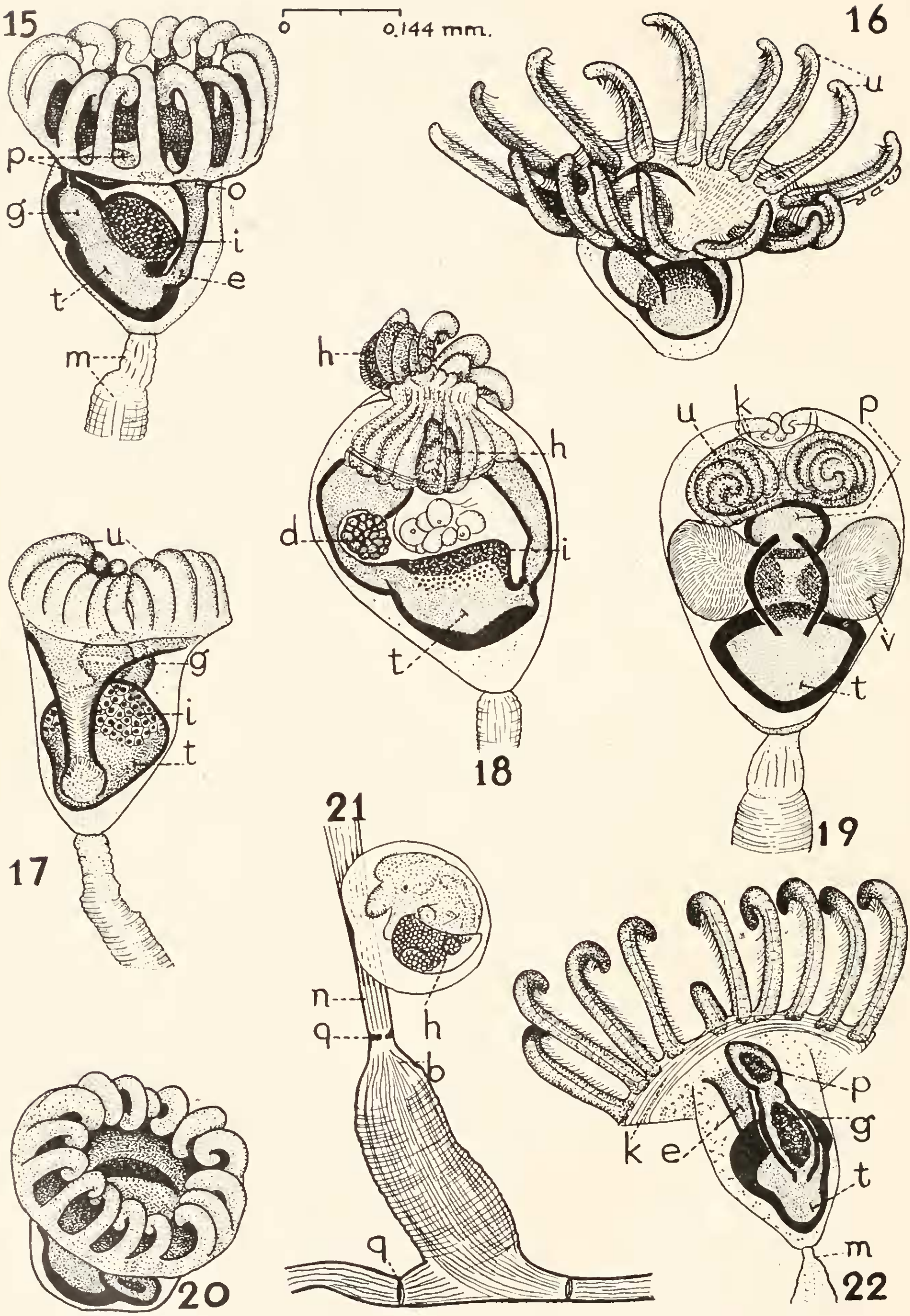
Figure 13. A typical small colony showing four whole individuals and two which had lost their calyces. Two of the stolons are quite long while the others are very short.

Figure 14. A very young zoid. No septum has yet formed to divide the stalk from the musclium.

Abbreviations Used on Plates

ao—Aboral organ
a—Anus
b—Basal enlargement or musclium
c—Calyx
d—Embryo
e—Esophagus
f—Flagella
g—Intestine
h—Larva
i—Liver
j—Mouth
k—Muscle fibers
l—Ovary
m—Pedicel
n—Peduncle
o—Pharynx
p—Rectum
q—Septum
r—Sperms
s—Stolon
t—Stomach
u—Tentacles
v—Testis
w—Velum

PLATE II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The body cavity or space between body wall and gut is quite empty-looking except for very sparsely arranged parenchymal cells whose meshes are exceedingly large (Figs. 24, 31), and whose few protoplasmic processes are very slender and attenuated. When living specimens were treated with a few drops of a 1 per cent aqueous Neutral Red solution the cytoplasm of some of the parenchyma cells took up the red color intensely while the nuclei remained light in color.

A pair of very small nephridia (Fig. 25) occur just in front of the testes, ovaries and back of the pharynx, just beneath the artial floor. They are very tiny and but for the intermittent flicker of their internal flagella would not have been noticed.

The nervous sytem is difficult to distinguish in living specimens except for a ganglion which is present behind the esophagus, above the liver and partially hidden by the ovarial tissue.

The musculature was not studied in much detail. Muscle fibers were observed leading to the esophagus (Fig. 24), in the body wall, lophophore, tentacles, digestive tract wall, stalk and muscular base.

Calyces were found either with (Figs. 18, 19, 23, 24) or without (Figs. 17, 22) reproductive organs. The latter condition was not uncommon, especially in very young zoids. There were calyces with male organs and calyces with female organs but hermaphrodites were not observed in the Woods Hole specimens. Further

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Explanation of Plate II

All figures on this plate were drawn with the aid of a camera lucida and to the same magnification, the scale of which is shown at the top of the plate. All are figures of *Barentsia laxa,* drawn from living specimens.

Figure 15. View of the right side of a young calyx, showing an empty gut but a very well developed "liver" (*i*, very coarsely stippled area). The zoid was without any apparent gonads as yet. Drawn VIII–16–1947.

Figure 16. View of opened lophophore showing the tentacle arrangement around its rim, the vestibule and mouth. The most heavily darkened crescent-shaped structure below the lophophore (in the calyx cup) is the "liver." It is not so large proportionately as in the preceding figure. The floor of the vestibule or atrium is slightly raised in the anal region.

Figure 17. Calyx as viewed from the esophageal side. The funnel-shaped pharynx-esophagus lies along the more flattened side of the calyx. The "cellular" formation directly behind the esophagus is the "liver." Drawn VIII–15–1947.

Figure 18. View of the right side of a female individual showing an ovary, an embryo (*d*), and two larvae (*h*). One larva is passing upward between the bases of the clustered tentacles. The other larva is ready for release and beginning to work its way out from among the tentacle tips. The thickness of the stomach wall sometimes varies and such variation is here shown. The lophophore is tightly contracted, temporarily. Drawn VIII–31–1947.

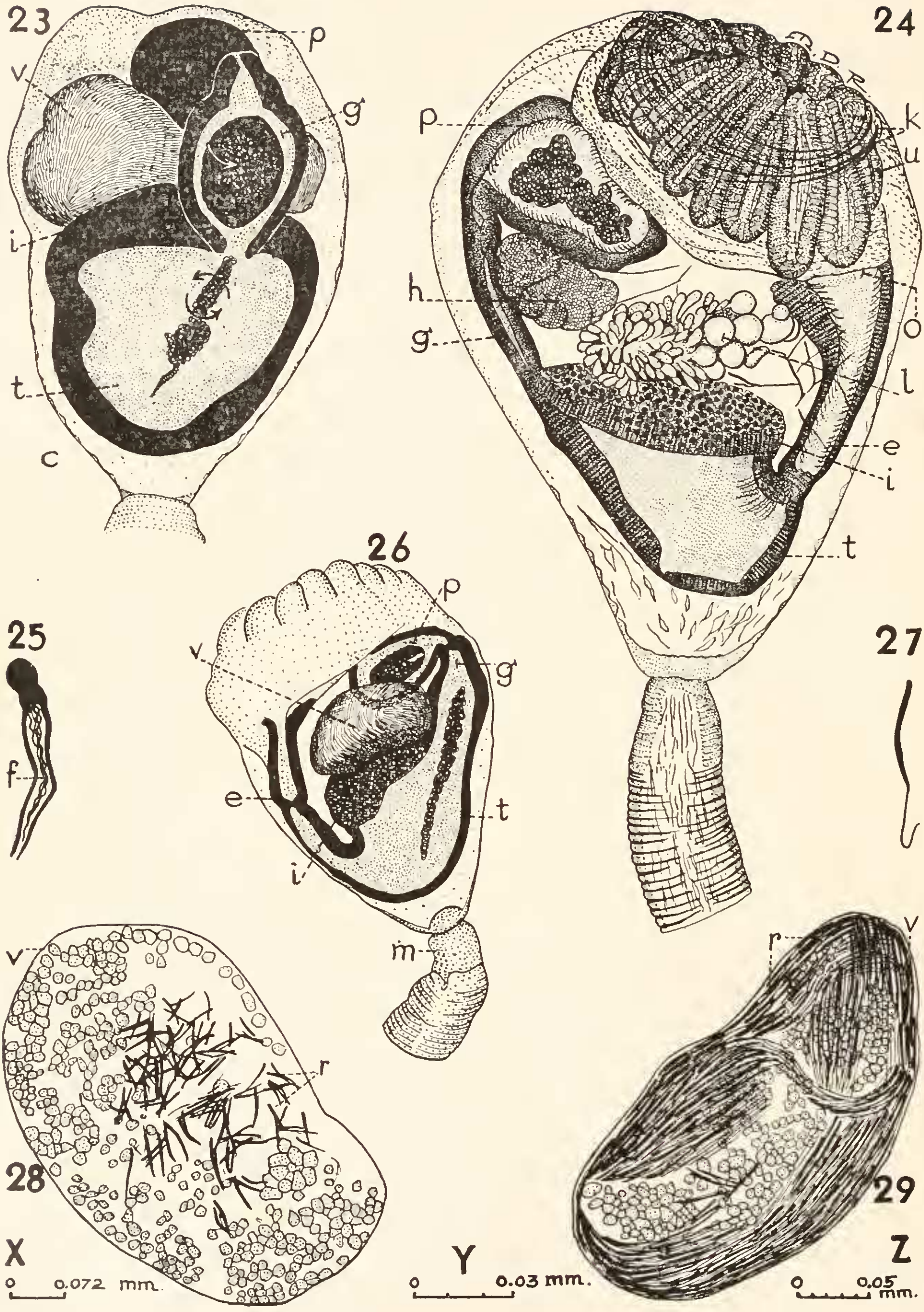
Figure 19. View of a male zoid from the intestinal side. The tentacles are folded temporarily into the vestibule or atrium and the lophophore rim is tightly contracted above them. The digestive tract is outlined heavily in black. The testes (*v*) are the two large masses above the stomach, one on either side of the intestine. Drawn VIII–31–1947.

Figure 20. View of tentacles curving inward, preparatory to the "closing" of the calyx.

Figure 21. Detail of swollen base or musclium, showing the direction of muscle fibers. On some specimens, as on this one, mollusk larvae (*h*) may be attached to the stalk or base. Drawn VIII–31–1947.

Figure 22. View of calyx from intestinal side. The digestive tract is heavily outlined in black. Two fecal pellets are shown, one in rectum, one in intestine. The circular musculature of the lophophore is indicated. No gonads were present in this zoid at this time. Drawn on VIII–17–1947.

Plate III



study is needed to determine if hermaphrodite specimens may occur in *Barentsia laxa*.

The male gonads are two large dense grey masses, one on either side in the space between liver, intestine and rectum (Figs. 19, 23, 26, 28, 29). Numerous sperms may be seen as fine thin lines within the testes (Figs. 27, 29). When mature the sperms show considerable flickering activity within the testes. Testes which have voided much of the sperm material are rather empty-looking (Fig. 28).

The ovaries are pictured in different stages of development in Figures 18 and 24. They are located above the liver, around the ganglion and slightly forward of the testis position.

Developing embryos seem to be pushed closer to the intestine, posteriorly to the ovary (Fig. 30).

Stalk

The stalks bearing the calyces are long, slender, flexible and generally separated from the basal enlargement by a partial septum. Their length varies with age. The young ones are very short (Fig. 14), the old ones are very long (Figs. 1, 3, 12, 13) and only occasionally show a tendency to become secondarily jointed or articulated along their extent (Figs. 2, 4, 5, 8). This secondary articulation was not previously known to occur in *Barentsia laxa*. The longest stalk measured slightly over 9 mm. in length. The Woods Hole *B. laxa* specimens were generally somewhat longer than those reported from other localities. Table I gives more complete data on these measurements.

The stalk terminology is somewhat confusing. Hincks (1888, p. 226) called the stiff, lower, proximal part of a *Barentsia major* stalk the "pedicel" and the

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Explanation of Plate III

All figures on this plate are of *Barentsia laxa* and were drawn with the aid of a camera lucida, from living material. Scale X applies to Figures 23, 26. Scale Y applies to Figures 25, 27, 28, 29. Scale Z applies to Figure 24.

Figure 23. A male zoid as seen from the posterior or intestinal side. The gut is heavily outlined in black. The two testes (*v*) are shown on either side of the intestine. The direction of rotation of the food mass in stomach and intestine is indicated by arrows. Reversal of direction follows after a short interval. Drawn on VIII–30–1947.

Figure 24. Enlarged view of the right side of a zoid which possesses an ovary, developing eggs and embryos. The liver is especially prominent in this specimen at time of sketching (VIII–7–1947). Cilia are diagrammatically shown in the pharynx, esophagus, stomach and rectum. They are also present in the intestine (here shown empty and collapsed) and in other parts of the stomach but are not here shown in all the areas in which they should occur. A mesh of a few strands of muscle fibers can be seen attaching to the esophagus. An embryonic mass is back of the ovary and directly below the rectum.

Figure 25. A nephridium.

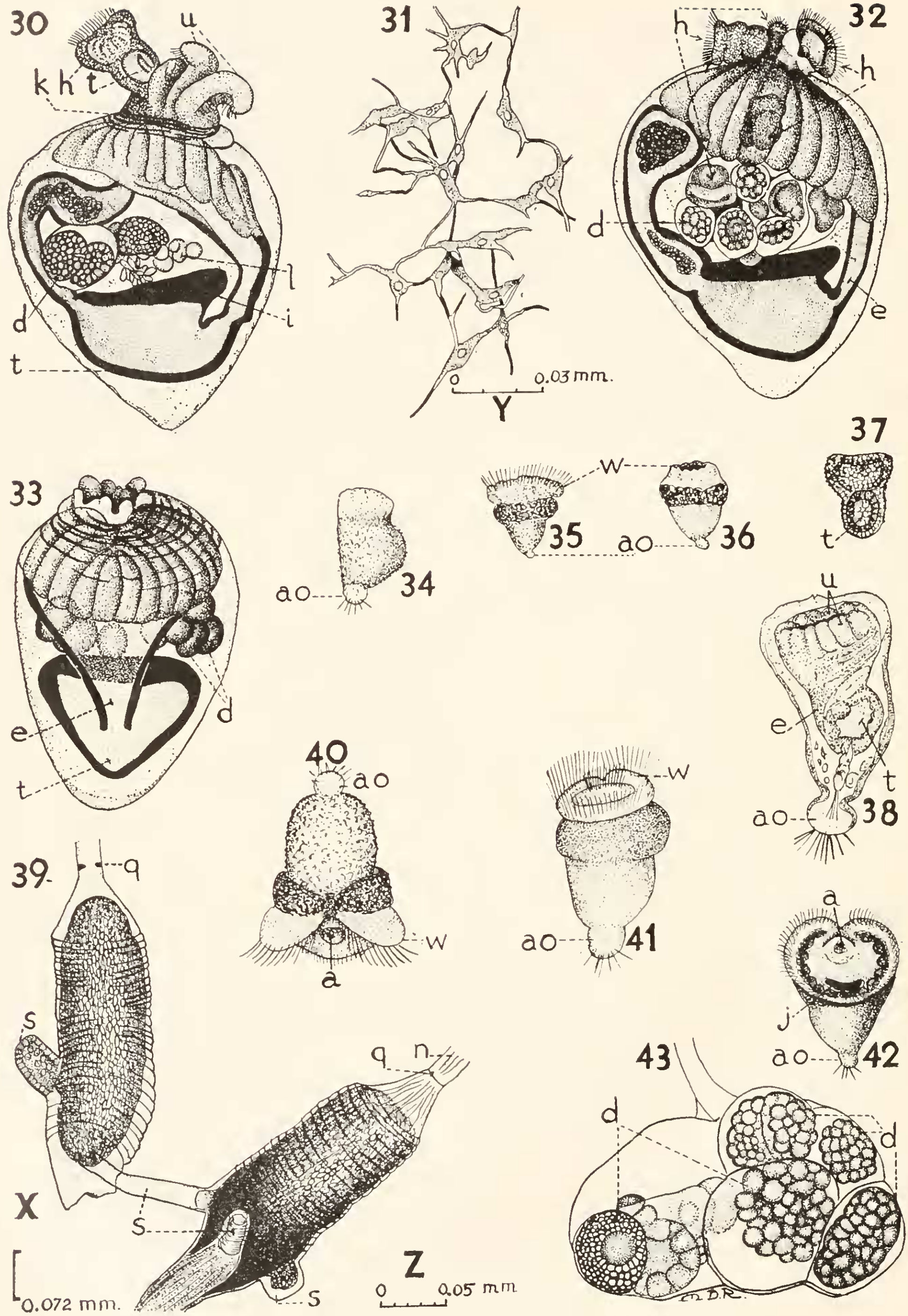
Figure 26. A male zoid seen from the left side. A long cord of mucus, to which is attached food material, is seen extending from the stomach into the intestine. The opening between the stomach and intestine was so large at this particular instant that their mutual boundary line was difficult to locate.

Figure 27. Diagram of a spermatozoon. Drawn VIII–30–1947.

Figure 28. A testis with relatively few spermatozoa in it. Drawn on VIII–30–1947.

Figure 29. A testis with many mature sperms in it, close to the limiting membrane. The sperms at this stage of development are a flickering mass of fine lines. Drawn on VIII–31–1947.

Plate IV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flexible, distal part nearest the head the "peduncle." Jullien and Calvet (1903, p. 27) reversed the names for the parts, calling the stalk segment nearest the head the "pedicellium" (pedicel) and the stalk segment nearest the enlarged base the "pediculium" (peduncle). The basal enlargement they labelled the "musclium basal." Jullien and Calvet's terminology seems to be more acceptable than Hincks' in this case.

The pedicel of *Barentsia laxa* is soft, flexible, annulated (Figs. 1, 7, 10, 12, 24). It is slightly and suddenly narrowed at its junction with the calyx (Figs. 19, 26). It also tapers, but very gradually, toward the less flexible lower portion of the stalk (peduncle). The pedicel is so flexible that it may coil very tightly into one

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Explanation of Plate IV

All figures are of *Barentsia laxa* and are drawn from living specimens. Figures 40 and 42 were drawn free-hand. The remainder were drawn with the aid of a camera lucida. Scale X applies to Figures 30, 32, 33, 34, 35, 36, 37 and 39. Scale Y applies to Figure 31. Scale Z applies to Figures 38, 41 and 43.

Figure 30. View of the right side of a female calyx carrying embryos in various stages of development. One larva is being released from between the tentacle tips. The parent digestive tract is heavily outlined in black.

Figure 31. A patch of the extremely diffuse parenchymal tissue which partially fills the body cavity or space between body wall and gut. It is quite inconspicuous in the calyx.

Figure 32. A female calyx as seen from the right side, carrying a number of embryos in various stages of development. Twelve embryos or larvae are visible from this side. Three larvae are clustered at the tips of the tentacles, ready for release. Two more are shown in the vestibule among the tentacles (near the tentacle bases), on their way upward and out. There are a number more enclosed in delicate transparent membranes between the liver and the tentacle bases. Drawn on IX–1–1947.

Figure 33. A female calyx seen from the esophageal side, showing nine multicellular embryonic masses whose cell detail is not shown. Collected on VIII–28–1947 and drawn three days later.

Figure 34. Left side of a young larva which had been released from the parent calyx an hour earlier. The flat and gibbose surfaces are very distinct in this view. The larval body covering is characteristically roughened.

Figure 35. Larva with velum or calyx edge expanded.

Figure 36. Same larva as shown in Figure 35 but with velum slightly contracted or bent inward. Drawn on IX–1–1947.

Figure 37. Recently released larva showing the stomach and the slightly roughened external surface. Aboral organ retracted into calyx at the moment. Drawn on VIII–31–1947.

Figure 38. Larva just at the instant of release, before it has had time to swim. Its digestive tract is well defined. The stomach, esophagus and vestibule are especially noticeable. Tentacle buds are distinguishable. Drawn on VIII–31–1947.

Figure 39. Basal enlargements of two zoids. The musclium at right shows four stolons; the one at left shows a stolon and a stolon bud. These basal enlargements are lined and partly filled with heavily granular cells which give them an opaque look. Drawn on VIII–18–1947.

Figure 40. A released larva seen from anal view, with aboral organ at top, ciliated velum expanded and anus visible near the indentation of the velum. Anal opening is functional at this stage. Drawn on IX–1–1947.

Figure 41. Another view of the same larva but with its calyx rim or velum (*w*) more contracted.

Figure 42. A recently released larva seen from the top, showing a fecal pellet, mouth and the dark, heavily granular tentacular area. The tentacles are not yet very distinct in this specimen.

Figure 43. A brood chamber with several larvae in different stages of development. The larval blastomeres are heavily granular. Some larvae have already been expelled, judging from the emptiness of the chamber. Drawn on IX–1–1947.

or two coils (Figs. 1, 2). This constant coiling and uncoiling is very annoying when one is trying to study anatomical details in living specimens. Sometimes, the zoids of the whole colony may be actively writhing and bumping heads. The annulations are very close together (Fig. 7, 24) and may or may not extend all the way down to the basal enlargement, depending upon the age of the zoid. Longitudinal muscle fibers occur inside the stalk.

Basal Enlargement

The basal enlargement or musclium is very distinct, even in young zoids (Figs. 3, 14, 21). It is cylindrical, tapering sharply and suddenly at its distal end to merge with the peduncle. Proximally, the musclium gives rise to one or more slender stolons which connect it with neighboring zoids (Fig. 9). It is closely annulated, very muscular and capable of some movement (Figs. 12, 21, 39). Some specimens are fairly transparent (Fig. 21). Others are quite opaque (Fig. 39) because of the numerous heavily granular cells within them. In the latter state the musculature appears to be outside the layers of opaque cells.

The cuticle of older basal enlargements thickens and turns yellow but the annulations are still visible.

Occasionaly one sees stalks of very long or old individuals swollen here and there (Fig. 5) and a basal musclium (b) making its appearance along the stalk. Some of these joints develop so completely that they sprout stolons (Figs. 2, 4, 8). This jointed condition is relatively rare, however.

Stolon

Stolons are slender, flexible, cylindrical, muscular connections between basal enlargements of various zoids (Figs. 2, 3, 4, 8, 13). They vary in length from 0.07 to 1 mm. They creep along the substratum over or along each other if crowded. Figure 8 shows a rather unusual condition, where a stolon has bent back to grow along a stalk from which it originated. If several arise from a musclium they do so at slightly different levels (Fig. 9). If only two stolons are present they are generally in a straight line across the slightly narrowed bottom of the musclium (Fig. 21). If four stolons are present, they are usually or approximately at right angles to each other, and in two lines, one line passing slightly above the other (Fig. 9).

Septa occur along the stolons near the musclium but have not been observed elsewhere along the stolon (Figs. 9, 21).

Calyx Regeneration

Colonies which are kept in the laboratory for any length of time begin to lose their heads, possibly because of inadequate food suply. The internal organs of the calyx degenerate and some of the calyces become quite empty (Fig. 10). Under these old degenerating calyces may develop a bud from the tip of the pedicel. This bud, which will form the new head, is separated from the old head by a thin protoplasmic strip (Fig. 10) which becomes thinner or narrower as time goes on, until the old head breaks away from the stalk at that point. For a short time the protoplasmic remnant projects from the new developing calyx (Fig. 11), then is obliterated by the growth of the calyx and the gradual healing of the break. New heads may therefore be found on old stalks. It would be interesting to see just how many times regeneration of a calyx could take place on the same stalk and how fast is the regeneration rate.

Stalks may remain viable and capable of writhing movement for a number of days without their heads.

When living specimens were stained with a 1 per cent aqueous Neutral Red solution the growing tip of the pedicel stained an intense pink in contrast to the pale pink color of the rest of the stalk and stolon.

Larvae

Developing *Barentsia laxa* embryos were found in considerable numbers from the last week in July to the first week in September, at Woods Hole. They very likely occur earlier and later than the dates indicated but the writer did not have the opportunity to collect them earlier or later than these dates.

Larvae and embryos in various stages of development were found simultaneously in the same calyx (Figs. 30, 32). The largest number of larvae observed in a parent zoid at any one time was nine but this very likely is not the maximum number. The larvae occupy the space above the liver, between the pharynx, intestine and rectum. They find their way out through a channel opening into the atrial floor and leave the body in front of the anal opening Several larvae may be released in succession (Fig. 32) within a few seconds or minutes of each other.

The larval digestive tract seems to be functioning just before the release of the larva from the parent. A fecal mass spins about in the gut of some of the about-to-be-shed larvae. Some larvae get rid of a fecal pellet just at the moment of their release from the parent calyx. The lophophore of the parent may be contracted or relaxed during the release of the larva. Within a few seconds after release, the larval body surface becomes roughened and debris-laden. The larvae swim about very actively for quite a time, some for at least an hour, others longer. During this interval the digestive tract becomes more clearly defined although the larval body wall is still fairly opaque. The shape of the larva becomes more gibbose, as in the adult calyx. The larval body is very flexible. Larvae undergo some bodily contortions of shortening and lengthening. They can retract their aboral organ, then extrude it again, may temporarily attach to the substratum by means of it, slide along the substratum on it, then let go and swim about actively again.

Anatomically, *Barentsia laxa* embryos show great similarity to embryos or larvae of *Pedicellina echinata,* judging from Hatschek's beautifully illustrated account of the development of the latter species.

Measurements of a recently released *Barentsia laxa* larva, with aboral organ retracted into body cavity, are as follows: length 0.144 mm., width at widest part 0.086 mm.

Miscellaneous Data

Some of the other animals found in association with the Woods Hole *Barentsia laxa* are mollusk larvae (veligers), Vorticellids, *Pseudofolliculina* (?) and the following Bryozoa: *Aeverrillia armata, Bowerbankia imbricata* and *Pedicellina* *cernua.* The veliger larvae are deposited in capsules along the *Barentsia* stalks, muscular bases or stolons (Fig. 21). They rotate or squirm about actively within their transparent globular capsules. The protozoa are found attached to the calyces and among the stolons. The Bryozoa grow over and among the stolons and enlarged bases of the *Barentsia* zoids.

Incidentally, this is the first report of the occurrence of *Bowerbankia imbricata* from the Woods Hole area. It has been observed on a number of occasions in the vicinity by the author.

Summary

1. This is the first report of *Barentsia laxa* and *Bowerbankia imbricata* from the immediate Woods Hole region.

2. A much more complete description, numerous measurements and more detailed illustrations of *Barentsia laxa* than have been previously available have been here presented.

3. Larval behavior, time of appearance and place of development for larvae of *Barentsia laxa* have been noted, to aid those who wish to make a further study of *B. laxa* embryology.

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